FOUNDATION INVESTIGATION REPORT

PROPOSED CUT BETWEEN STA 26+775 AND 26+825
HIGHWAY 26 FROM MEAFORD TO THORNBURY

G.W.P. 57-00-00
Agreement # 3006-E-0002

I.E. Group

MTO GEOCRES No. 41A-204

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Prepared for:

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N2H 6M7

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Prepared by:

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07-6-IEG1-A-CUT

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Geocres No.: 41A-204

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PART A – FOUNDATION INVESTIGATION

1.0 INTRODUCTION

This report presents the results of a foundation investigation carried out in September and November 2007 and April 2008 by Infrastructure Engineering Group Inc. (IEG) on behalf of Stantec Consulting Ltd. (Stantec).

This assignment involves the rehabilitation of the pavement structure on Highway 26 from 0.2 km east of the Thornbury west limits (Peel Street) westerly 10.06 km to the Town of Meaford east limit.

It includes the rehabilitation and extension of two existing structural culverts, as well as many non-structural culvert extensions and replacements. The project also includes intersection realignments, intersection improvements, construction of two new 1.5 km long passing lanes, minor horizontal and vertical alignment improvements and electrical work. The original assignment included the re-alignment of the Blue Mountains/Meaford Town Line which has been deleted from the assignment.

Foundation investigation and recommendations are required for the design and construction of culvert replacements and extension as part of the improvement of Highway 26. Two (2) structural culverts, twenty-four (24) non-structural culverts, two shale bin replacements, and a high cut area are to be investigated. There is a change in the scope of work to include two additional culvert additions which were not part of the original scope of work for foundation investigations, and re-allocation of the foundations investigation work for three (3) CSP culverts to the geotechnical investigation portion of this assignment. This report covers the site of high cut area between STA 26+775 and 26+825.

The purpose of the investigation was to obtain information about the subsurface conditions at the site by means of boreholes and test pits, and based on the findings, to provide geotechnical recommendations for the proposed cut slope between STA 26+775 and 26+825.

Authorization to complete this assignment was given by Mr. Dan Green, P. Eng., of Stantec Consulting Ltd., the TPM Consultant who is completing this assignment for MTO under Agreement # 3006-E-0002.

2.0 SITE DESCRIPTION

2.1 Site Location

A new eastbound passing lane will be constructed approximately between STA 25+700 and 27+200. Based on the proposed profile provided by Stantec, the height of the cut is 5.1 m and the depth of cut is 2.0 m between STA 26+775 and 26+825. The anticipated high cut area is located approximately 3.6 km east of the east limit of the Town of Meaford. Photographs of this proposed cut area is presented in Appendix “D”.

The existing slope is either grassed or moderately treed. A shallow drainage ditch is present between the toe of the cut slope and the highway. The existing pavement platform in this area consists approximately of 7 m wide pavement, and wider than 3 m shoulders. The existing embankment cut slope on the south side of Highway 26 is typically 2.5H : 1V or flatter, with heights ranging from 0.5 m to 3 m. No signs of embankment slope instability were observed at the time of these field investigations. Seepage was not observed on the slope face during the investigations in the Summer and Fall of 2007 and in the Spring of 2008.

2.2 Physiography and Topography

The Town of Meaford is situated at the mouth of the Bighead River where the river enters Nottawasaga Bay, part of the Georgian Bay of Lake Huron.

The subsurface of the Town of Meaford is comprised of predominately silty clay, and smooth to gently sloping topography. Pockets of sand and gravelly sands exist which also exhibit smooth to gently sloping topography.

The Town is located on the coastal plain left by glacial Lake Algonquin. East of Meaford, the Algonquin shore cliff coincides with the base of the Niagara Escarpment. The coastal plain in this area consists of sand and gravel beach terraces overlying the bedrock. Overburden thickness is generally less than 5 m.

Bedrock consists of the shale and limestones of the Georgian Bay Formation. Grey, impure carbonate beds (limestone and dolomite) alternate with grey and blue/grey shale.

West of Meaford, the coastal plain consists of the same beach deposits as found in the east. To the west away from the Lake, overburden becomes a glacio-lacustrine derived silt to clayey till. Numerous drumlins of calcareous till with red shale inclusions are found in the Meaford area.

Progressing west on Highway 26 toward Owen Sound and the Niagara Escarpment, the bedrock types progress from Queenston shales, the Clinton and Cataract shales and dolomites to the cap rock of the Amabel dolomites and limestones. Overburden thickness can be as much as 15 m, but is generally less than 5 m.

The asphalt pavement surface is near elevation 235.3 m at the centerline of Highway 26 while the high ground surface elevation at the anticipated cut area is approximately 3 m higher at approximately elevation 238 m.

3.0 INVESTIGATION PROCEDURES

3.1 Field Investigation

On September 8 and 18, 2007, a truck-mounted CME 55 drill rig was supplied by London Soil Test Ltd. and used on site for drilling and Standard Penetration Testing (SPT, following the procedures of ASTM D 1586). Two (2) boreholes (Boreholes CUT-A1 and CUT- A2) were drilled and sampled to obtain data or foundation design of the proposed cut slope. Boreholes were put down approximately 7 m from the centerline of the existing pavement in the gravel shoulder area. These borehole locations were chosen due to the presence of an excessive amount and lack of details of underground services in the cut area.

On November 2, 2007, a truck-mounted post hole auger supplied by Ottewell Enterprises Ltd. for auger sampling of the cut area. Two (2) boreholes (Boreholes CUT-A3 and CUT-A4) were located in the shallow ditch area (at the toe of the existing slope) and auger samples were taken to obtain data or foundation design of the proposed cut slope. These two boreholes were terminated at shallow depths due to auger refusal.

On April 16, 2008, a track-mounted excavator supplied by Sutherland Construction was used to dig two (2) test pits (Test Pits CUT-A5 and CUT- A6) which were located near the top of the anticipated cut area. The use of test pits was due to accessibility problems with no permissions granted to enter by property owner. The test pits were logged by our field engineer and bulk samples were taken to obtain data or foundation design of the proposed cut slope. These two test pits were terminated at depths of 2.2 and 2.7 m below ground surface.

The locations of the boreholes and test pits are shown on Drawing 1. The depths of sampling are as follows:

Reference	Depth of Sampling (m)
Borehole CUT-A1	3.51
Borehole CUT-A2	3.51
Borehole CUT-A3	1.22
Borehole CUT-A4	1.31
Test Pit CUT-A5	2.20
Test Pit CUT-A6	2.70

The boreholes were drilled using continuous flight solid stem augers. Soil samples were retrieved at selected intervals throughout the depths of Boreholes CUT-A1 and CUT-A2 in conjunction with Standard Penetration Tests (SPT). Samples were generally taken at intervals of depth of 0.75 m to the maximum depth of exploration.

Bulk soil samples were taken from the auger cuttings of Boreholes CUT-A3 and CUT-A4 and Test Pits CUT-A5 and CUT-A6 for laboratory testing, including grain size analyses, Atterberg Limits and standard Proctor Density Testing.

Field pocket penetrometer was used on the retrieved relatively undisturbed bulk samples obtained from the test pits, where applicable, to determine the undrained shear strength of the cohesive soil deposits. It is noted that the measured shear strength value would be slightly lower than the actual value due to sampling disturbance.

Seepage and water levels were noted in each borehole and test pit during and at the completion of drilling and sampling. All boreholes were grouted with a bentonite/cement mix at completion of sampling in accordance with Ontario Regulation 903. The test pits were backfilled in 0.5 m thick layers and each layer compacted by the bucket of the excavator.

Our field engineer, Mr. Ralph Billings, P. Eng., supervised the fieldwork and worked under the direction of the project engineer, Mr. Eric Chung, P. Eng. Our field staff cleared the location of buried utilities and logged the boreholes. The soil samples obtained were placed in labeled containers and transported to IEG’s London laboratory for further examination and laboratory testing.

The stations, offsets and ground surface elevations at the as drilled borehole and test pit locations were surveyed by AGM London and provided to IEG for the purpose of this report.

The results of the drilling, sampling, in-situ testing and groundwater observations are summarized on the Record of Borehole and Test Pit log sheets and enclosed in Appendix “A”.

3.2 Laboratory Analysis

Geotechnical laboratory testing consisted of natural moisture content determinations and visual classifications of all retrieved soil samples. In addition, grain size analyses, laboratory standard Proctor tests, Atterberg Limit tests and unit weight tests were performed on selected samples.

The results of the laboratory testing are presented on the Record of Borehole and Test Pit sheets (Appendix “A”), and Laboratory Test Results (Figures 1 and 2, Appendix “B”).

4.0 SUBSURFACE CONDITIONS

4.1 General Subsurface Conditions

Reference is made to the Record of Borehole and Test Pit sheets (Appendix “A”) and Laboratory Test Results (Appendix “B”) for detailed subsurface soil and groundwater conditions encountered in the boreholes. The stratigraphic boundaries shown on the Record of Borehole and Test Pit sheets are inferred from non-continuous sampling and, consequently, represent transitions between soil types rather than exact planes of geological change. The soil profiles depicting the subsurface conditions on Drawing 1 will vary between and beyond the borehole and test pit locations.

In general, very stiff to hard silty clay till with embedded sand and gravel and large shale pieces was encountered in the test pits and boreholes. A trace of seepage was observed at Test Pit Cut-A5 during excavation.

4.1.1 Fill, Topsoil

Borehole CUT-A1 and A2, which were located in the gravel shoulder area approximately 7 m south of the centerline of Highway 26, encountered 150 mm shoulder gravel.

The ground surface of Boreholes CUT-A3 and A4, located approximately 12 m from the centerline of Highway 26 at the toe of the existing slope, was covered by a 25 mm thick layer of topsoil.

The ground surface of Test Pits CUT-A5 and A6, located approximately 20 m from the centerline of Highway 26 at the top of the anticipated cut area, was covered by a 25 mm thick layer of topsoil.

4.1.2 Silty Clay Till

A major deposit of brown silty clay till with embedded sand and gravel and large shale pieces was contacted below the granular fill and topsoil of the boreholes and test pits. The silty clay till extends beyond the vertical limit of the test pits and boreholes at a maximum depth of 3.51 m below the present ground surface. Eight (8) grain size analyses were performed on the silty clay till deposit and the results are presented on Figure 1 of Appendix “B”.

Standard penetration tests yielded “N”-values from 17 to over 100 blows per 0.3 m. Typical “N”-values are between 16 and 35 with a single high value of over 100 blows per 0.3 m. The “N”-values of 100 blows per 0.3 m encountered in Sample 2 of BH CUT-A2 was due to cobbles (or large shale pieces). Eight (8) samples were tested and exhibited the following Atterberg Limits. These results are shown in Figure 2 of Appendix “B” and summarized below:

Liquid Limit (W_L)	30 to 59%, average at 40.3%
Plastic Limit (W_P)	20 to 25%, average at 22.6%
Plasticity Index (I_p)	12 to 35%, average at 18.0%

The natural moisture contents were in the range of 12 to 28%. These results are characteristic of clayey soils of low to high plasticity (CL-CI). It is noted that the more plastic soils were encountered in the upper stratum of the silty clay till. The measured natural moisture contents are near or below the measured plastic limits and indicate that the deposit is pre-consolidated.

Based on the above field and laboratory test results, together with visual and tactile examination, the silty clay till deposit exhibited generally very stiff to hard consistency.

A unit weight test yielded a value of 20.3 kN/m^3. Five (5) laboratory standard Proctor tests were performed and the results are presented below:

Maximum Dry Density (MDD)	1820 to 2000 kg/m^3, average 1918 kg/m^3
Maximum Wet Density (MWD)	2042 to 2356 kg/m^3, average 2201 kg/m^3
Optimum Moisture Content (W_{opt})	11.0 to 17.8%, average 13.0%

4.2 Groundwater Conditions

The groundwater condition was monitored during and upon completion of sampling. On completion of drilling, free groundwater was not observed in all four boreholes and two (2) test pits. A trace of seepage was observed at Test Pit Cut-A5 during excavation. This condition can be attributed to spring thaw condition.

It should be noted that the groundwater level will fluctuate seasonally and in response to weather events.

5.0 STATEMENT OF LIMITATION

We recommend that once the details of the proposed structure are finalized, our recommendations should be reviewed for their specific applicability.

The Limitations of Report, as Quoted in Appendix "C", is an integral part of this report.

We trust that we have completed the assignment within the Terms of Reference for this project. If there are any questions concerning this report, please do not hesitate to contact our office.

Yours truly,
Infrastructure Engineering Group Inc.

LICENSED PROFESSIONAL ENGINEER
E.Y. CHUNG
8345506
Mar 13-09
PROVINCE OF ONTARIO

Eric Y. Chung, M.Eng., P.Eng.
Designated MTO Contact

Joseph Law, P.Eng.
Project Manager

Tom O'Dwyer, P. Eng.
Quality Review Engineer

LICENSED PROFESSIONAL ENGINEER
J.L.
J. C-Y. LAW
MAR 13/09
PROVINCE OF ONTARIO

Drawing 1 Borehole & Testpit Locations And Soil Strata

METRIC

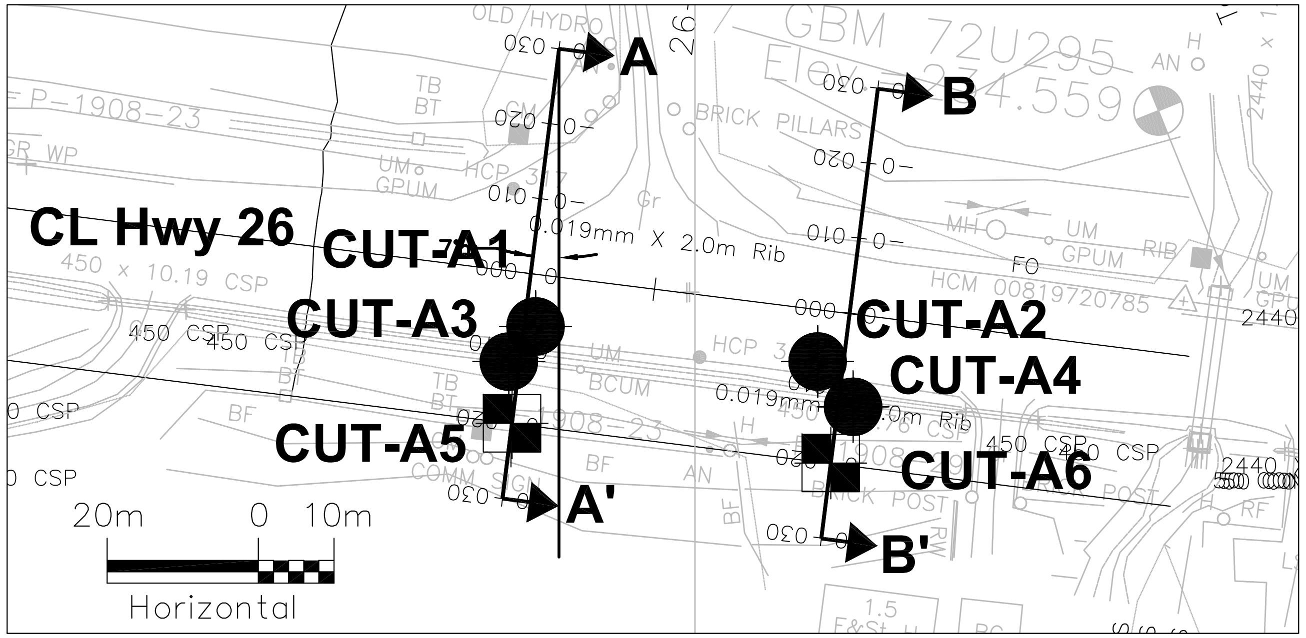
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No xxxx–xxxx
WP No GWP 57–00–00

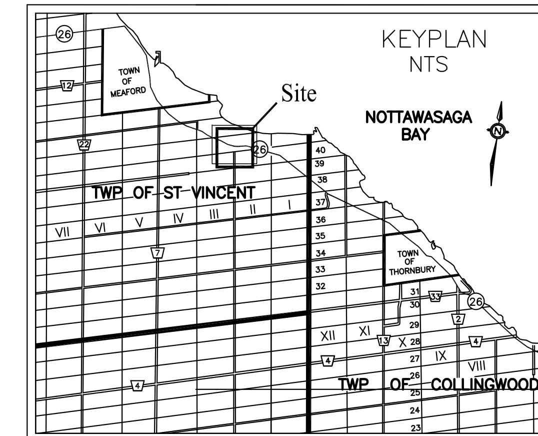
HIGH CUT
STA 26+775 TO 26+825
Highway 26
BORE HOLE LOCATIONS & SOIL STRATA

SHEET 1

I.E. Group — Infrastructure Engineering Group Inc. Pavement & Construction Materials Consulting Engineers. GTA • Kitchener • London • Windsor

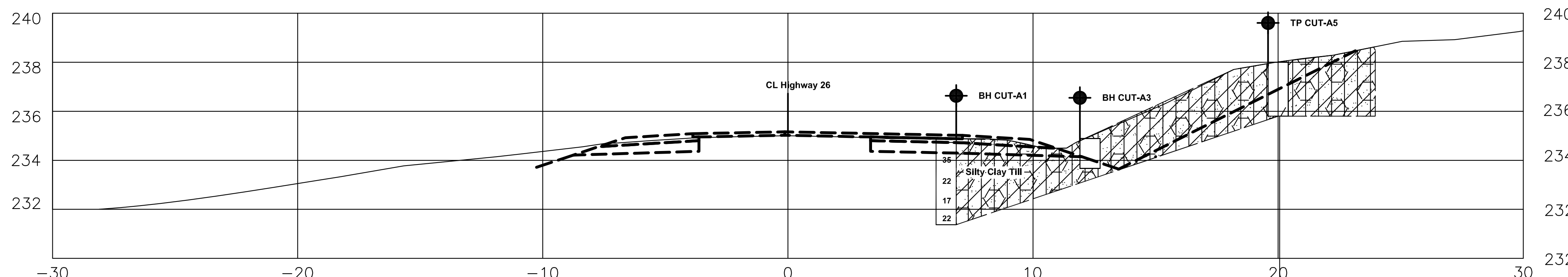


BOREHOLE LOCATION PLAN

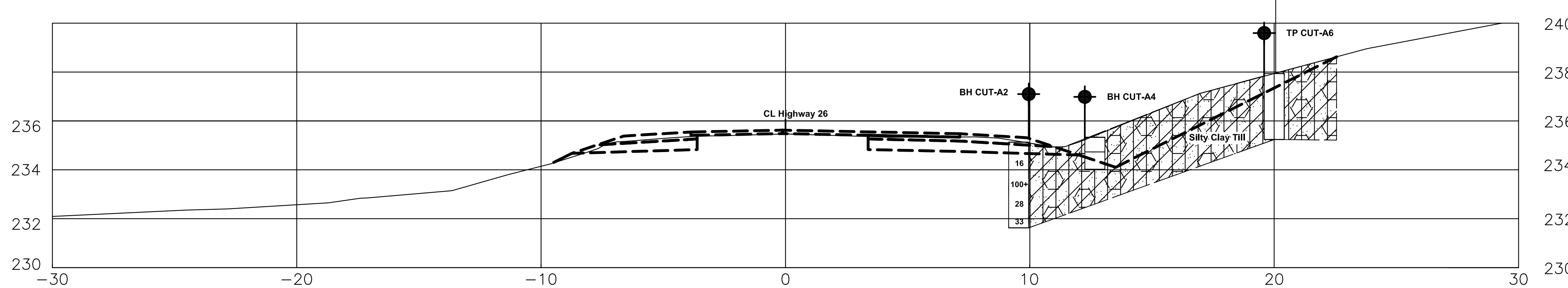


LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- N — Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE — Blows/0.3m (60° Cone, 475 J/blow)
- W L at time of investigation
- Standpipe
- Testpit



SECTION A-A'



SECTION B-B'

10m 0 5m
Horizontal and Vertical

TESTHOLE NO.	ELEVATION	UTM CO-ORDINATES NORTH	EAST
BH CUT–A1	234.83	4939088	222279
BH CUT–A2	235.13	4939083	222316
BH CUT–A3	234.89	4939083	222275
BH CUT–A4	235.33	4939077	222321
TP CUT–A5	238.00	4939069	222276
TP CUT–A6	237.87	4939075	222318

NOTES

1. THE COMPLETE FOUNDATION INVESTIGATION AND DESIGN REPORT FOR THIS PROJECT AND OTHER RELATED DOCUMENTS MAY BE EXAMINED AT THE ENGINEERING MATERIALS OFFICE, DOWNSVIEW. INFORMATION CONTAINED IN THIS REPORT AND RELATED DOCUMENTS ARE SPECIFICALLY EXCLUDED IN ACCORDANCE WITH THE CONDITIONS OF SECTION GC2.01 of OPS GEN. COND.
2. THE BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATIONS. BETWEEN BOREHOLES AND BOUNDARIES ARE ASSUMED FROM GEOLOGICAL EVIDENCE.
3. SUBGRADE ELEVATION OF THE EXISTING FOOTING NOT KNOWN AND IS ESTIMATED TO BE AT 1.2m BELOW THE CREEK BED.
4. THIS DRAWING IS FOR SUBSURFACE INFORMATION ONLY. SURFACE DETAILS AND FEATURES ARE FOR CONCEPTUAL ILLUSTRATION.

REVISIONS	DATE	BY	DISCRIPTION
	09/03/09	J.L.	Final
	08/05/08	J.L.	Draft

Geocres : 41A–204

HWY No. HWY 26		DIST Owen Sound	
SUBM'D J.L.	CHECKED E.C.	DATE 08/05/08	SITE CUT–A
DRAWN J.L.	CHECKED J.L.	APPROVED E.C.	DWG 1

Appendix A

Explanation of Terms Used in Report

Record of Borehole & Testpit Sheets

Boreholes CUT A1 to A4

Testpit CUT A5 & A6

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS $\bar{N}$

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	>200
	VERY SOFT	*SOFT*	*FIRM*	*STIFF*	*VERY STIFF*	*HARD*

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	>50
	VERY LOOSE	*LOOSE*	*COMPACT*	*DENSE*	*VERY DENSE*

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND / OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (R Q D), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	*POOR*	*FAIR*	*GOOD*	*EXCELLENT*

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	>3m
JOINTING	*VERY CLOSE*	*CLOSE*	*MOD. CLOSE*	*WIDE*	*VERY WIDE*
BEDDING	*VERY THIN*	*THIN*	*MEDIUM*	*THICK*	*VERY THICK*

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa^{-1}	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m^2/s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY $= \frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m^3	DENSITY OF SOLID PARTICLES
γ_s	kN/m^3	UNIT WEIGHT OF SOLID PARTICLES
ρ_w	kg/m^3	DENSITY OF WATER
γ_w	kN/m^3	UNIT WEIGHT OF WATER
ρ	kg/m^3	DENSITY OF SOIL
γ	kN/m^3	UNIT WEIGHT OF SOIL
ρ_d	kg/m^3	DENSITY OF DRY SOIL
γ_d	kN/m^3	UNIT WEIGHT OF DRY SOIL
ρ_{sat}	kg/m^3	DENSITY OF SATURATED SOIL
γ_{sat}	kN/m^3	UNIT WEIGHT OF SATURATED SOIL
ρ'	kg/m^3	DENSITY OF SUBMERGED SOIL
γ'	kN/m^3	UNIT WEIGHT OF SUBMERGED SOIL
e	1, %	VOID RATIO
n	1, %	POROSITY
w	1, %	WATER CONTENT
S_r	%	DEGREE OF SATURATION
w_L	%	LIQUID LIMIT
w_P	%	PLASTIC LIMIT
w_s	%	SHRINKAGE LIMIT
I_P	%	PLASTICITY INDEX $= w_L - w_P$
I_L	1	LIQUIDITY INDEX $= \frac{w - w_P}{I_P}$
I_C		CONSISTENCY INDEX $= \frac{w_L - w}{I_P}$
e_{max}	1, %	VOID RATIO IN LOOSEST STATE
e_{min}	1, %	VOID RATIO IN DENSEST STATE
I_D	1	DENSITY INDEX $= \frac{e_{max} - e}{e_{max} - e_{min}}$
D	mm	GRAIN DIAMETER
D_n	mm	n PERCENT - DIAMETER
C_U	1	UNIFORMITY COEFFICIENT
h	m	HYDRAULIC HEAD OR POTENTIAL
q	m^3/s	RATE OF DISCHARGE
v	m/s	DISCHARGE VELOCITY
i	1	HYDRAULIC GRADIENT
k	m/s	HYDRAULIC CONDUCTIVITY
j	kN/m^3	SEEPAGE FORCE

RECORD OF BOREHOLE No CUT-A1

METRIC

W.P. GWP 57-00-00 LOCATION Northing - 4939088, Easting - 222279 ORIGINATED BY JL

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY JL

DATUM Geodetic DATE 09.08.07 - 09.08.07 CHECKED BY EC

ELEV DEPTH	SOIL PROFILE DESCRIPTION	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
234.83	Ground					
0.00	150 mm sand and gravel FILL.					
	SILTY CLAY TILL, CI-CL Brown, moist, hard to very stiff, with embedded sand and gravel and shale fragements.	1	SPT	35		2 18 46 33 (80)
		2	SPT	22		10 29 37 25 (62)
		3	SPT	17		12 29 37 22 (59)
		4	SPT	22		
231.32 3.51	End of borehole.					Borehole dry and open @ completion.

Strat plot labels: CI, CL. Elevation scale: 234, 233, 232. Liquid limit value: 41.

Bulk Sample
MDD = 1820 Kg/m^3
W_{opt} = 11.5%
MWD = 2029 Kg/m^3

Column headings: PENETR. RESISTANCE STANDARD ● DYN. CONE 20 40 60 80 100; SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100; PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30; UNIT WEIGHT γ kN/m^3

$+^3, \times^3$: Numbers refer to Sensitivity ○ 150 UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No CUT-A2

METRIC

W.P. GWP 57-00-00 LOCATION Northing - 4939083, Easting - 222316 ORIGINATED BY JL

DIST Owen Sound HWY 26 BOREHOLE TYPE S/S Augering, 110 mm dia. COMPILED BY JL

DATUM Geodetic DATE 09.18.07 - 09.18.07 CHECKED BY EC

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
235.13	Ground					
0.00	150 mm sand and gravel FILL.				235	
	SILTY CLAY TILL, CI-CL Brown, moist, hard to very stiff, with embedded sand and gravel and shale fragements.	1	SPT	16	234	2 19 47 32 (79)
		2	SPT	100+		hit cobble
		3	SPT	28	233	13 27 36 25 (60)
		4	SPT	33	232	
231.62 3.51	End of borehole.					Borehole dry and open @ completion.

Column headings: SOIL PROFILE; SAMPLES; GROUND WATER CONDITIONS; STRAT PLOT; PENETR. RESISTANCE STANDARD ● DYN. CONE 20 40 60 80 100; SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100; PLASTIC LIMIT w_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT w_L, WATER CONTENT (%) 10 20 30; UNIT WEIGHT γ kN/m³

+ ³, × ³: Numbers refer to Sensitivity

○ ¹⁵⁰ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No CUT-A3

METRIC

W.P. GWP 57-00-00 | LOCATION Northing - 4939083, Easting - 222275 | ORIGINATED BY JL

DIST Owen Sound HWY 26 | BOREHOLE TYPE BACKHOE WITH S/S Augering ATTACHMENT, 150 mm dia. | COMPILED BY JL

DATUM Geodetic | DATE 11.02.07 - 11.02.07 | CHECKED BY EC

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE / SHEAR STRENGTH kPa	WATER CONTENT (%) (W_P / W / W_L)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
234.89	Ground										
0.00	25 mm TOPSOIL										
	SILTY CLAY TILL, CI-CL Brown, moist, very stiff, with embedded sand and gravel and shale fragements		1	AUGER							
			2	AUGER			234		59		23 16 38 24 (62)
233.67 / 1.22	End of borehole. Bulk Sample MDD = 1970 Kg/m³ W_{opt} = 12.5% MWD = 2216 Kg/m³										Auger refusal @ 1.2 m. Borehole dry and open @ completion

PENETR. RESISTANCE: STANDARD ● DYN. CONE (20 40 60 80 100)

SHEAR STRENGTH kPa: O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE (20 40 60 80 100)

PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT; WATER CONTENT (%) 10 20 30

+ 3, X 3: Numbers refer to Sensitivity

O 150 UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF BOREHOLE No CUT-A4

METRIC

W.P. GWP 57-00-00 LOCATION Northing - 4939077, Easting - 222321 ORIGINATED BY JL

DIST Owen Sound HWY 26 BOREHOLE TYPE BACKHOE WITH S/S Augering ATTACHMENT, 150 mm dia. COMPILED BY JL

DATUM Geodetic DATE 11.02.07 - 11.02.07 CHECKED BY EC

ELEV / DEPTH	SOIL PROFILE – DESCRIPTION	SAMPLES – NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT (WATER CONTENT %)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
235.33	Ground								
0.00	25 mm TOPSOIL.	1	AUGER			235			
	SILTY CLAY TILL, CI-CL Brown, moist, very stiff, with embedded sand and gravel and shale fragements.	2	AUGER				47		2 6 40 51 (91)
234.02 / 1.31	End of borehole. Bulk Sample MDD = 1840 Kg/m³ W_{opt} = 11.0% MWD = 2042 Kg/m³								Auger refusal @ 1.3 m. Borehole dry and open @ completion

PENETR. RESISTANCE: STANDARD ● DYN. CONE 20 40 60 80 100

SHEAR STRENGTH kPa: O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100

W_P W W_L — WATER CONTENT (%) 10 20 30

$+^3, \times^3$: Numbers refer to Sensitivity

O [150] UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF TESTPIT No CUT-A5

METRIC

W.P. GWP 57-00-00	LOCATION Northing - 4939069, Easting - 222276		ORIGINATED BY JL
DIST Owen Sound HWY 26	TESTPIT TYPE BACKHOE		COMPILED BY JL
DATUM Geodetic	DATE 04.16.08 - 04.16.08		CHECKED BY EC

ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	PENETR. RESISTANCE / SHEAR STRENGTH kPa	WATER CONTENT (%) (w_P – w – w_L)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
238.00	Ground										
0.00	TOPSOIL										
237.59 / 0.41	Silty CLAY TILL (CI-CH) Brown, moist to wet, stiff, with large embeded shale pieces (up to 200 mm)		1	GRAB			237 / 236		o ├──┤		33 12 50 5 (55)
235.80 / 2.20	End of testpit Bulk Sample MDD = 2000 Kg/m³ W_{opt} = 12.1% MWD = 2356 Kg/m³										Minor water ingress at bottom of testpit.

PENETR. RESISTANCE: STANDARD ● DYN. CONE 20 40 60 80 100
SHEAR STRENGTH kPa: O UNCONFINED + FIELD VANE; ● QUICK TRIAXIAL × LAB VANE; 20 40 60 80 100
PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30

$+^3, \times^3$: Numbers refer to Sensitivity

$\circ^{150}$ UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

RECORD OF TESTPIT No CUT-A6

METRIC

W.P. GWP 57-00-00 | LOCATION Northing - 4939075, Easting - 222318 | ORIGINATED BY JL

DIST Owen Sound HWY 26 | TESTPIT TYPE BACKHOE | COMPILED BY JL

DATUM Geodetic | DATE 04.16.08 - 04.16.08 | CHECKED BY EC

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	NATURAL MOISTURE CONTENT w	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
237.87	Ground								
0.00 / 237.46	TOPSOIL								
0.41 / 235.17	Silty CLAY TILL (CI-CH) Brown, moist to wet, stiff, with large embeded shale pieces (up to 200 mm)	1	GRAB			237 / 236	o	20.3	
2.70	End of testpit Bulk Sample MDD = 1960 Kg/m³ W_{opt} = 17.8% MWD = 2303 Kg/m³								Testpit dry and open at completion

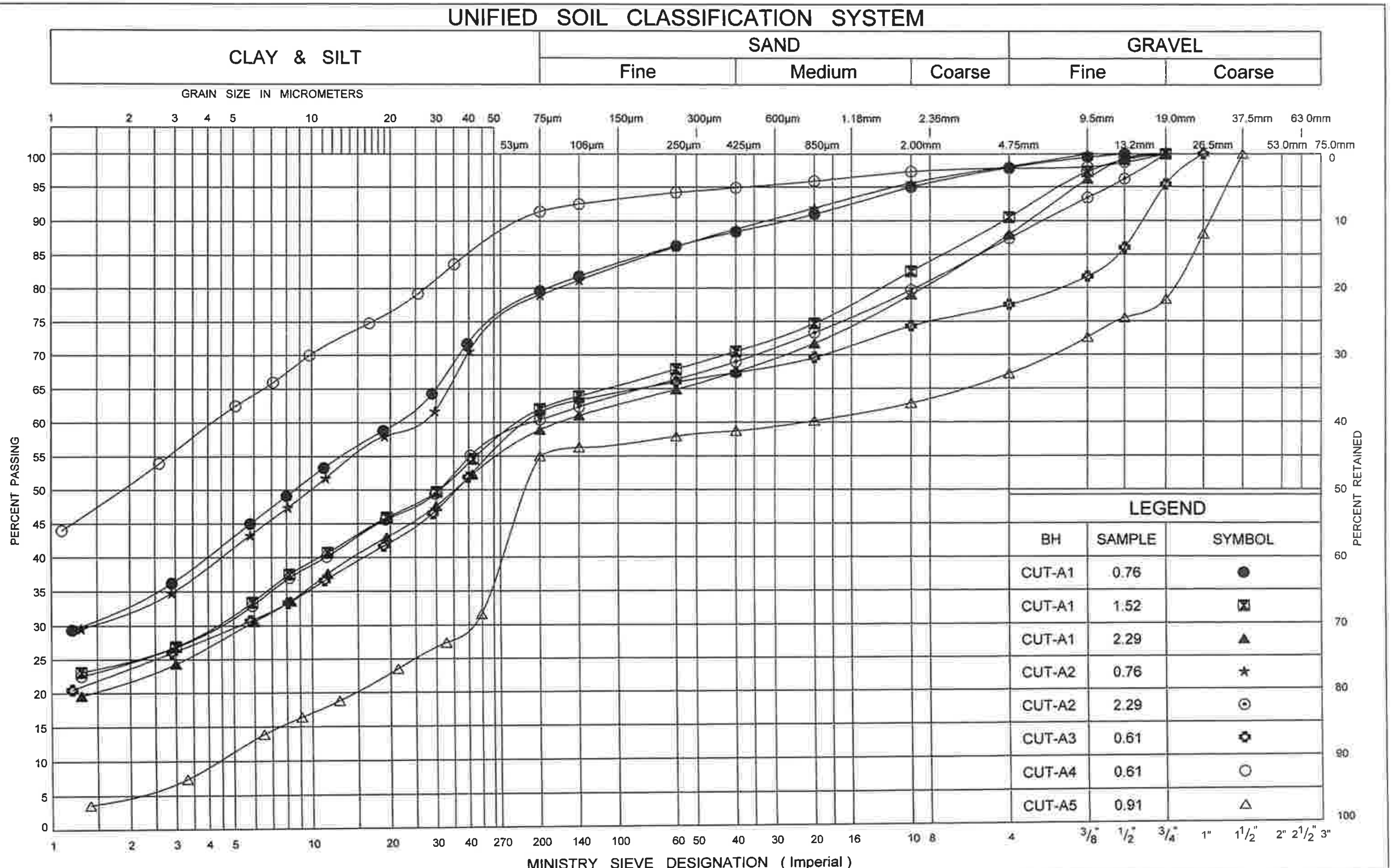
Column headings: SOIL PROFILE; STRAT PLOT; SAMPLES; PENETR. RESISTANCE STANDARD ● DYN. CONE (20 40 60 80 100); SHEAR STRENGTH kPa: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, X LAB VANE (20 40 60 80 100); PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30.

$+^{3}, \times^{3}$: Numbers refer to Sensitivity

O [150] UNCONFINE SHEAR STRENGTH INFERRED FROM POCKET PENETROMETER READINGS

Appendix B

Laboratory Test Results



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Ontario

GRAIN SIZE DISTRIBUTION

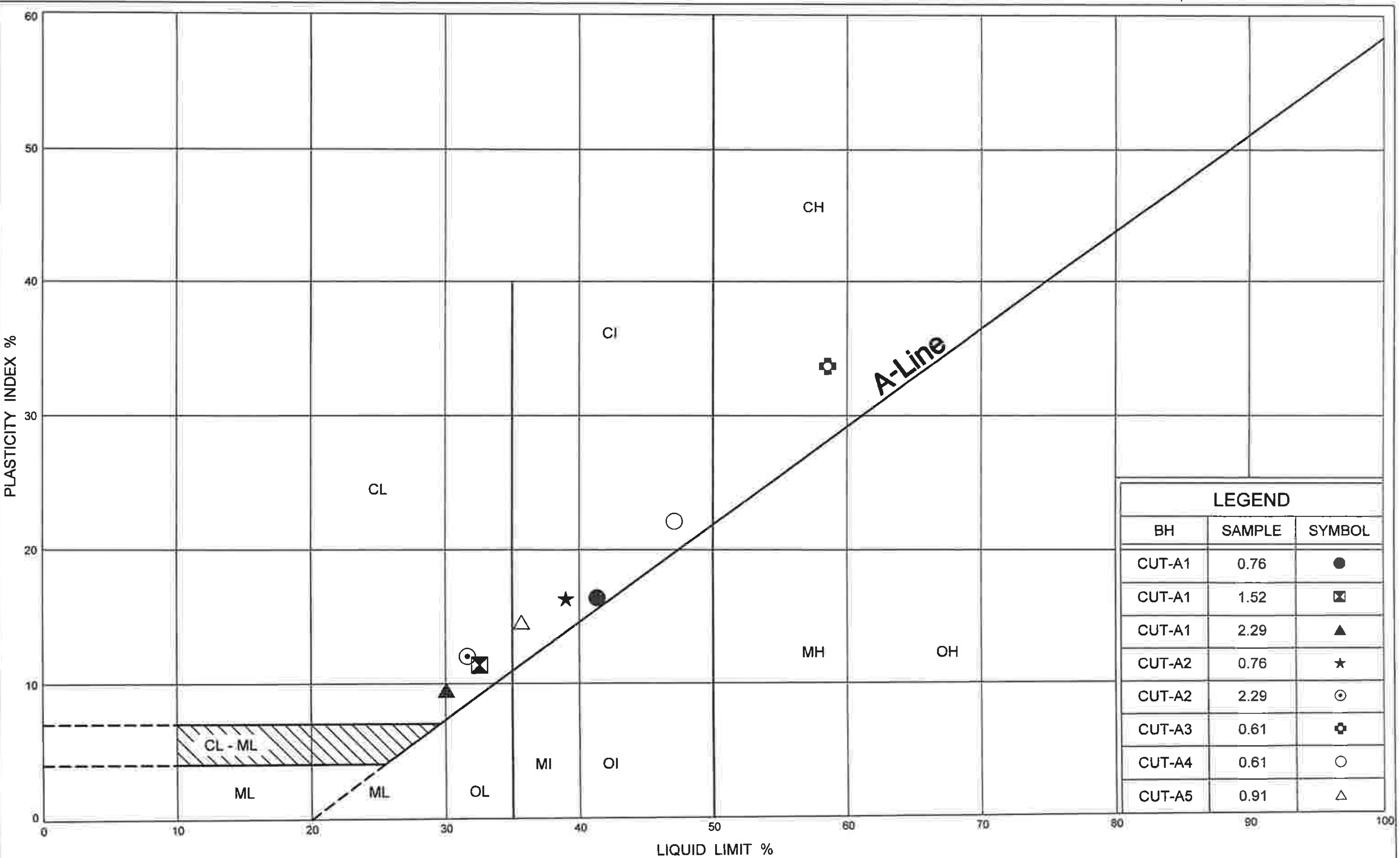
SILTY CLAY TILL WITH SHALE PIECES, CL-CI

FIG No CUT A.1

GWP 57-00-00

HWY 26, Thornbury to Meaford

Oct 75, FF - S - 21



LEGEND

BH	SAMPLE	SYMBOL
CUT-A1	0.76	●
CUT-A1	1.52	⊠
CUT-A1	2.29	▲
CUT-A2	0.76	★
CUT-A2	2.29	⊙
CUT-A3	0.61	✿
CUT-A4	0.61	○
CUT-A5	0.91	△

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Ontario

PLASTICITY CHART

SILTY CLAY TILL WITH SHALE PIECES, CL-CI

FIG No CUT A.2

GWP 57-00-00

HWY 26, Thornbury to Meaford

Appendix C

Limitations of Report

APPENDIX C

LIMITATIONS OF REPORT

The conclusions and recommendations given in this report are based on information determined at the testhole locations. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the testhole locations, and conditions may become apparent during construction which could not be detected or anticipated at the time of the site investigation. It is recommended practice that the Soils Engineer be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in the testholes.

The comments made in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of testholes may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusion as to how the subsurface conditions may affect their work.

The benchmark and elevations mentioned in this report were obtained strictly for use in the geotechnical design of the project and by this office only, and should not be used by any other parties for any other purposes.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Infrastructure Engineering Group Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

This report does not reflect the environmental issues or concerns unless otherwise stated in the report.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report. Since all details of the design may not be known, IEG recommends that we be retained during the final design stage to verify that the design is consistent with our recommendations, and that assumptions made in our analysis are valid.

Appendix D

Site Photographs

GENERAL VIEW OF CUT AREA ON LEFT HAND SIDE, May 1, 2006

PROXIMITY OF BELL SERVICE LINE TO TESTPIT, April 16, 2008

VIEW FROM TOP OF SLOPE LOOKING NORTH-WEST (STA 26+825), April 16, 2008

VIEW FROM SHOULDER LOOKING SOUTH-EAST (STA 26+800), April 16, 2008

VIEW FROM TOP OF SLOPE LOOKING NORTH (STA 26+775), April 16, 2008